Electricity Meters IEC/MID
Residential

ZxF100Ax/Cx s2

E350 series 2 (ZxF100Ax/Cx)

User Manual

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Revision history

Version	Date	Comments
a	24.07.2009	First edition
b	18.01.2010	Example absolute value summation corrected, channel configuration table updated with OBIS codes and remarks, instantaneous power accuracy added, new section 2.4 "Radio Interference", description of power up display corrected, range of CDS and NDS display durations corrected, description of error display changed, meter display list updated (without display text), description of optical interface enhanced, description of manufacturer specific mode C-C added, description of optical test outputs enhanced, minor formatting and text improvements.
c	05.05.2010	New display list items, Combined sum integrated in channel configuration (section 1.6); Summation modes updated, SW-version presentation updated, Disconnector tamper added, More detailed explanation of disconnector icon, table of required measuring times updated, display status messages added, error and status code explanation extended, addressability added, advice (restriction) for SW-version <= M23 added, Availability for disconnector added

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Introduction

Range of validity

The present manual applies to the following E350 series 2 meter versions:

Three-phase four-wire network

- **ZMF100AC** and **ZMF100AB** for active energy (import and export)
- **ZMF100CC** and **ZMF100CB** for active and reactive energy (import and export)

Three-phase three-wire network

- **ZFF100AC** and **ZFF100AB** for active energy (import and export)
- **ZFF100CC** and **ZFF100CB** for active and reactive energy (import and export).

For a detailed explanation of the type designation see section 1.6.

Purpose

The user manual contains all information required for meter applications for the intended purpose. This includes:

- Provision of knowledge concerning characteristics, construction and knowledge of meters
- Information regarding possible dangers, their consequences and measures to prevent any danger
- Details concerning the performance of all work throughout the service life of the meters (parameterisation, installation, commissioning, operation, maintenance, shutting down and disposal)

Target group

The content of this user manual is intended for technically qualified personnel of energy supply companies, responsible for system planning, installation and commissioning, operation, maintenance, decommissioning and disposal of meters.

Reference documents

The technical data and functional description of the meters can be found in separate documents:

- D000027981 "Technical Data ZxF100Ax/Cx, series 2"
- D000028645 "Functional Description ZxF100Ax/Cx, series 2"

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1 Description of Unit

1.1 General View

Fig. 1.1 General view of meter (with GSM/GPRS Module)

1.2 Purpose of Use

The ZMF100 meters record active and reactive energy consumption in all 3-phase 4-wire networks. They are directly installed in the supply line by the energy supply company and are read regularly for billing purposes.

The ZFF100 meters differ from ZMF meters in the type of measurement (Aron circuit for three-phase three-wire networks). Therefore, they are only equipped with 2 instead of 3 measuring elements.

The data is displayed on an LCD and is also available via optical interface and with an AMR Module via CS, PLC modem, GSM/GPRS or Ethernet modem, etc. When provided with transmission contacts, the meters can also be used as transmission contact meters for telemetering. The rates can be controlled internally or externally with control inputs (on the AMR Module).

With an AMR module, the meters can also be used to record counting pulses of other physical media (e. g. water or gas volumes) or to directly transmit values recorded by other measuring devices.

Any other application of these meters is regarded as abuse.

1.3 Advice

Inverted rectifiers used in larger photovoltaic installations may cause disturbance currents at high frequencies and lead to additional errors. Although the meters still comply with the specification we recommend not to use SW-version M21, M22, M23 in these applications.

1.4 Field of Application

Basic series

The basic version provides energy registers for tariffication, red test diodes for active and reactive energy, an optical interface for meter reading and an interface for various communication forms. This interface is protected against fraud and is independent of the module suppliers. The exchangeable AMR Module is situated outside the calibration liability. The functionality of this meter is suitable for smaller consumers, i.e. for households.

Disconnector (ZxF100xB only)

The function of the disconnector is customer specific and is defined by the communication module. Possible uses: anti-tampering (e.g. disconnection in case of tampering with magnets), load limitation (fuse control), remote disconnect (e.g. in case of change of tenant), prepayment. The status of the disconnector is displayed on the meter, but the disconnector is controlled by the communication module. If you need detailed information on the functionality of your disconnector, please consult the user manual of the communication module installed.

The disconnector is available for connection on 3x 230/400 V only.

Extensions

The basic series can be extended with various AMR Modules for additional functions and communications:

- Multirate import/export with external rate control
- S0 pulse output
- Communication via PLC, GSM/GPRS, or other media.

The meter functions which can be used in the system are defined by the module (e.g. a 2 rate module is not able to control 6 rates in the meter).

Therefore, meter and module together define the functionality range which can be used.

As the meter has a wide range of configuration possibilities, a specific behaviour can in some cases differ from the description below.

Parameterisation

The meters can be parameterised, i.e. specific parameters can be set with software, so that the meters can be supplied according to the specific wishes of the relevant utility.

Retroactive modification of the parameters is not possible.

The parameters stored in the meter are protected against unauthorised overwriting.

Details about parameter settings can be found in the functional description.

1.5 Characteristics

The meters have the following characteristics:

- Recording of active and reactive energy in all 4 quadrants (ZMF100Cx) or recording of active energy imported and exported (ZxF100Ax) with up to 6 rates
- Rate control performed via AMR module
- Data display on LCD
- Measuring elements in DFS technology (Direct Field Sensor based on Hall Effect) with excellent measuring characteristics, including flat load curve, high stability and good protection against interference.

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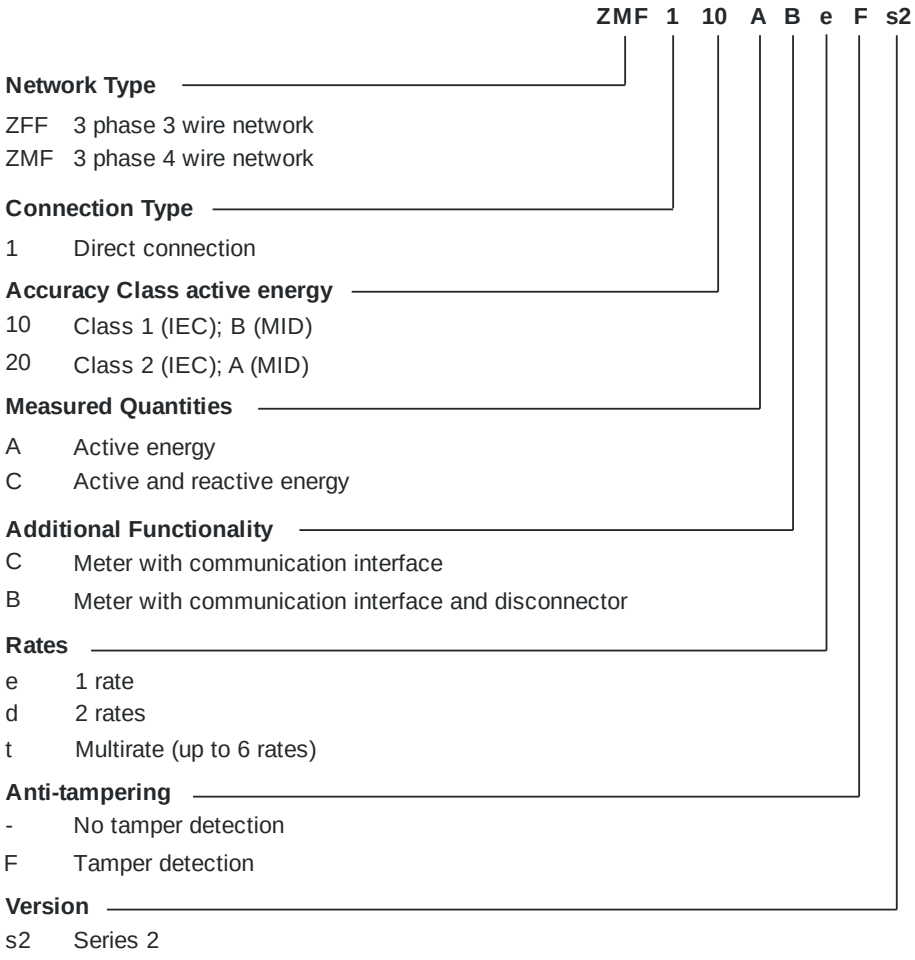
- Active energy measurement accuracy: Classes 1 and 2 (IEC62053-21) and MID accuracy classes A and B (EN50470-3)
- Reactive energy measurement accuracy: Class 2 (IEC62053-23)
- Correct measurement even with only one or two phases
- Wide range measurement from starting current to maximum current
- Serial interface with optical input/output for automatic readout of data on the spot and for service functions
- AMR interface (connection to communication module) for meter reading and tariff control according to IEC 62056-21
- Storage of event information (e.g. power outages)
- Installation aids (e.g. phase voltages and direction of energy)
  - Presence of phase voltages (voltage values are displayed)
  - Visual output (creep indicator) on LCD
  - Display of energy direction
  - Power indication

1.6 Type Designation



The “e” for the 1-rate execution can be skipped in some executions.

The AMR Module is not part of this type designation, since it is a complete unit in itself. Users can change it without opening the calibration seal.

1.7 Measuring Principle

1.7.1 Overview

Inputs

The main meter inputs are:

- Phase connection (L1, L2, L3) and neutral for
  - energy measurement
  - three-phase power supply of the meter
  - PLC communication with communication modules (all phases prepared)
- Display button
- Disconnector button (only if meter equipped with disconnector)

Outputs

The main meter outputs (partly also inputs) are:

- LCD to display measured values and the corresponding OBIS code
- Optical test outputs (red, one for active and one for reactive energy)
- Optical interface for automatic data readout on site by means of a suitable HHT (Hand Held Terminal) (also input)
- Secured AMR Interface for automatic data readout through an AMR module, e.g. E35C module, with a PLC, GSM/GPRS or other medium (also input).

Power supply

The supply voltage for the meter electronics is taken from the three-phase system. A voltage monitor guarantees a safety data storage in the event of a mains voltage failure and a correct start-up after the return of the voltage.

Memory

A non-volatile memory (EEPROM) contains the parameter set of the meter and secures the stored measurements against loss due to power failure.

1.7.2 Signal generation

The three measuring elements, DFS (Direct Field Sensor based on Hall effect), register the phase currents with the magnetic field of the current loops and the phase voltages over a resistor divider. The analog/digital converters transform both signals into digital voltage and current data. This data is then multiplied by a digital multiplier to produce an energy proportional value. The resulting value is fed into the microprocessor, which adds the value to the corresponding values of the other phases and the sum is then transferred into the corresponding energy registers (rate-dependent).

The microprocessor generates pulses for the test diodes from the digital sum to the meter constant R.

1.7.3 Signal processing

The meter records active and reactive energy and can distinguish between energy import and export in up to 6 rates (depending on configuration).

Calibration

Calibration data is stored during the final testing of the meter.

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Start detection

The microprocessor compares the measured power with the minimum starting power. The signals are only passed on for summation if the minimum starting power is exceeded.

Measured quantities

The following energy values can be measured and stored in the registers:

- Active energy A
- Reactive energy R
- Apparent energy S

The signals +A and +R are formed by summation for *imported* measured active and reactive energy. The signals –A and –R are formed by summation for *exported* measured active and reactive energy. The combined totals are the sum of the absolute values of +A and –A or +R and –R.

Energy type:	kWh, kvarh or kVAh
Direction:	Import, export, ± reactive
Source:	Individual phase, summed etc.
Instantaneous Values:	Voltage, current, frequency, power factor

Measurement channels

There are 6 independent measurement channels. One of the measured quantities can be assigned to each of this register.

Energy registers

Each measurement channel has 6 rate registers and 1 total register. 42 registers are therefore available in total.

All registers work internally with 9 digits. The internal magnitude is Wh (Watt-Hours). They cannot be reset. At 999999999, a rollover to 0 takes place. The display and readout formats vary from the internal format.

Rates

The meter is designed for up to 6 rates. The assignment of the rate registers is done by means of parameterisation and is shown on the face plate.

Rate control is performed by the external module.

Rate control

With up to 2 rates, the rate switching is operated by the AMR Module directly or by control inputs. The rate switching for more than 2 rates can be operated only by the AMR module.

Summation methods

Summation can take place in different ways:

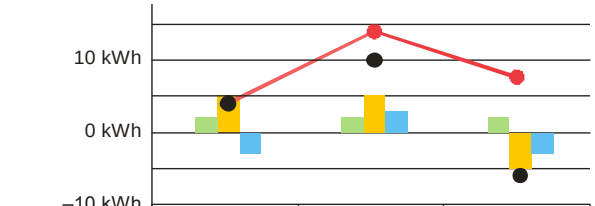
Summation by vectors +A/–A

"Ferraris mode":
As in Ferraris meters the meter summates the values of the individual phases taking account to the sign. With differing signs (energy directions) the sum corresponds to the difference between the positive and negative values as shown in the figure below.

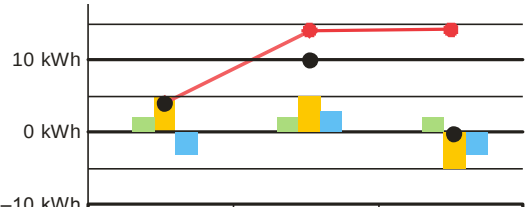
If the vectorial sum of the three vectors A_{L1}, A_{L2}, A_{L3} is positive, then active energy is imported (+A).

If the vectorial summation of all three vectors A_{L1}, A_{L2}, A_{L3} is negative, then active energy is exported (–A). See following figure.

The same applies to reactive energy. A distinction of the different quadrants is also possible.



	1st hour	2nd hour	3rd hour
L1	2 kWh	2 kWh	2 kWh
L2	5 kWh	5 kWh	-5 kWh
L3	-3 kWh	3 kWh	-3 kWh
Sum	4kWh	10 kWh	-6 kWh
Sum kum	4 kWh	14 kWh	8 kWh



	1st hour	2nd hour	3rd hour
L1	2 kWh	2 kWh	2 kWh
L2	5 kWh	5 kWh	-5 kWh
L3	-3 kWh	3 kWh	-3 kWh
Sum	4kWh	10 kWh	0 kWh
Sum kum	4 kWh	14 kWh	14 kWh

Fig. 1.2 Example vectorial summation active energy (left ±A, right: only +A)

Summation by quantity (magnitude) Σ+A/Σ–A

Summation by quantity separates the positive from the negative values of the individual phases. Measured quantity Σ+A therefore only includes the positive values (+A_1 and +A_3 in example 1), measured quantity Σ–A only the negative values (–A_2 in example 1), provided any are present.

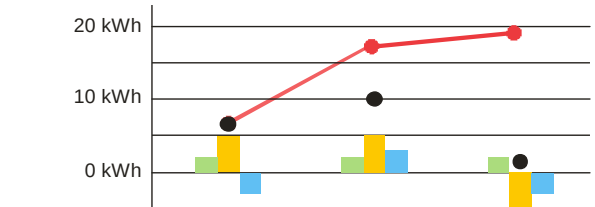
In case of a connection error the meter measures correctly the real energy consumption. It also measures a real export in the correct way.

For active energy import (+A) only positive magnitudes of A_{L1}, A_{L2}, A_{L3} are counted. Negative magnitudes of A_{L1}, A_{L2}, A_{L3} are discarded.

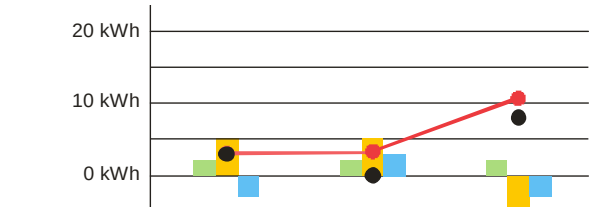
For active energy export (–A) only negative magnitudes of A_{L1}, A_{L2}, A_{L3} are counted. Positive magnitudes of A_{L1}, A_{L2}, A_{L3} are discarded.

The same applies to reactive energy. A distinction of the different quadrants is also possible.

The following examples show the magnitude summation for active energy import (left) and for active energy export (right).



	1st hour	2nd hour	3rd hour
L1	2 kWh	2 kWh	2 kWh
L2	5 kWh	5 kWh	-5 kWh
L3	-3 kWh	3 kWh	-3 kWh
Sum	7 kWh	10 kWh	2 kWh
Sum kum	7 kWh	17 kWh	19 kWh



	1st hour	2nd hour	3rd hour
L1	2 kWh	2 kWh	2 kWh
L2	5 kWh	5 kWh	-5 kWh
L3	-3 kWh	3 kWh	-3 kWh
Sum	3 kWh	0 kWh	8 kWh
Sum kum	3 kWh	3 kWh	11 kWh

Fig. 1.3 Example magnitude summation active energy (left: +A, right –A)

Summation by single quantities Σ |A Lx|

This method summates the quantity of the individual phases independent of the energy direction. A connection error – however – has no effect on the result of measurement.

But if there is a real export in one phase, this method leads to incorrect measurement results.

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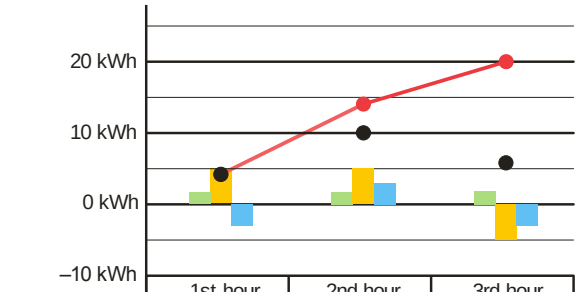
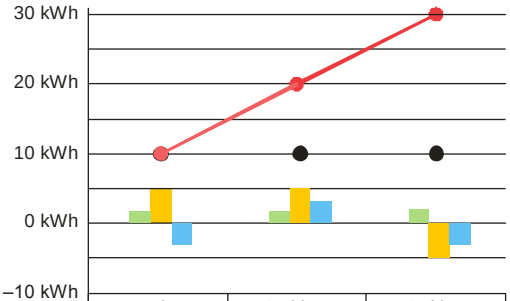
Summation by Absolute value |+A| + |–A|

With this method the meter adds exported and imported energy. This method only makes sense if the utility is sure there is no energy export. This method is available in vectorial and magnitude summation mode.

The absolute magnitude summation can be used as an anti-tampering measure. Here negative magnitudes of A_{L1}, A_{L2}, A_{L3} are added to the positive magnitudes of A_{L1}, A_{L2}, A_{L3}. See example below.



	1st hour	2nd hour	3rd hour
L1	2 kWh	2 kWh	2 kWh
L2	5 kWh	5 kWh	-5 kWh
L3	-3 kWh	3 kWh	-3 kWh
Sum	4kWh	10 kWh	6 kWh
Sum kum	4 kWh	14 kWh	20 kWh



	1st hour	2nd hour	3rd hour
L1	2 kWh	2 kWh	2 kWh
L2	5 kWh	5 kWh	-5 kWh
L3	-3 kWh	3 kWh	-3 kWh
Sum	10 kWh	10 kWh	10 kWh
Sum kum	10 kWh	20 kWh	30 kWh

Fig. 1.4 Example absolute value summation active energy (left: combined sum, vectorial, always positive; right: combined sum, magnitude, always positive per phase)

Subtraction |+A| – |–A|

With this method the meter subtracts an exported energy from the imported. It cannot detect a connection error.

Use of vectorial and magnitude mode

ZFF meters must work in vectorial mode – we don't have energy values for each phase (3 phases and only 2 measurement systems).

For ZMF most of the customers use vectorial mode too. Only some customers use magnitude mode, mainly for tamper prevention.

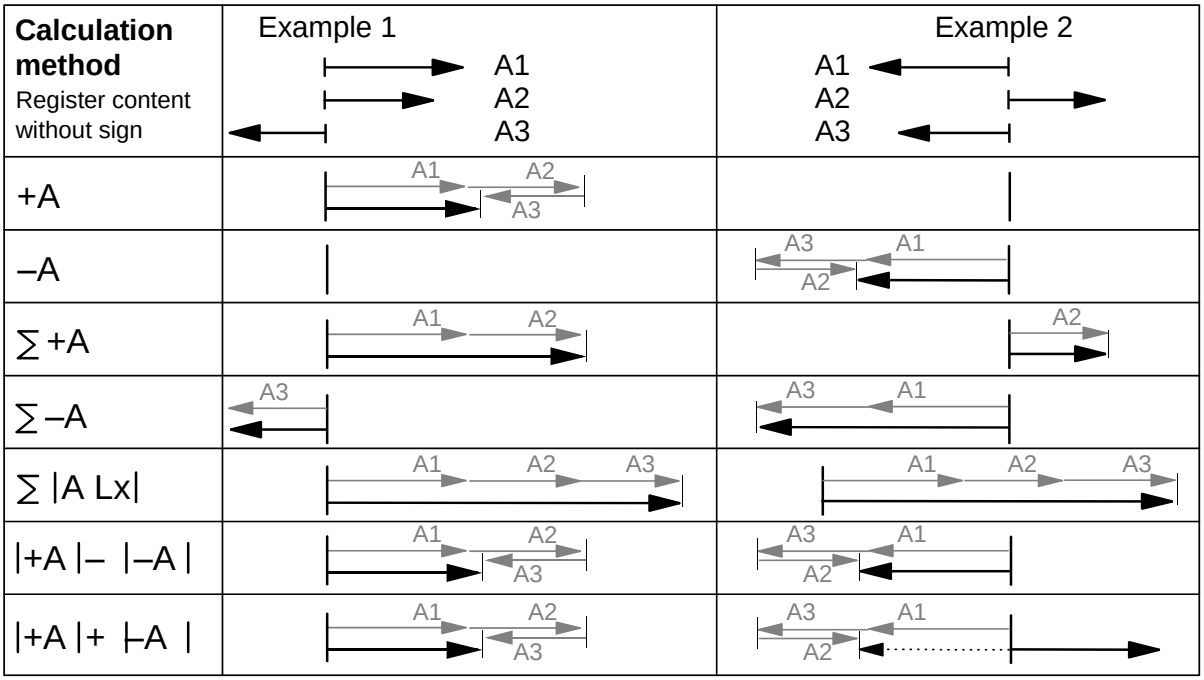


Fig. 1.5 E350 –Phase summation samples

Further measurement quantities

In addition to the usual quantities, the measured quantities active, reactive and apparent energy have further possibilities such as:

Subtraction of reactive energy	|+R| – |–R|
Addition of reactive energy	|+R| + |–R|
Quadrants	+Ai, +Ac, –Ai, –Ac
etc.	

Further samples

More samples and applications are shown in the functional description.

4-quadrant measurement

The reactive energy (±Rc, ±Ri) is allocated to the 4 quadrants as follows:

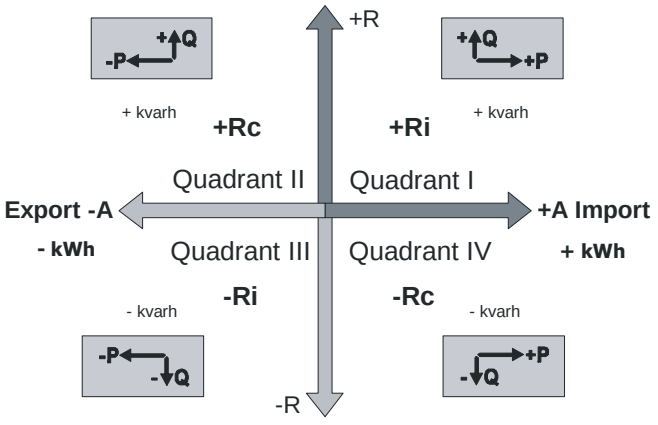


*Fig. 1.6 4-quadrant measurement (only in ZxF100**C**x meters)*

The reactive energies of the individual phases can be allocated to the 4 quadrants in the same way.

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Channel configuration To each of the 6 available channels a measured quantity can be assigned by parameterisation. The following table shows some of the most common measured quantities used:

Value	OBIS	Direction	Quadrant(s)	Phase	Unit	Remarks
+A	1.8.0	Import	I + IV	Sum	kWh	1
+A	1.8.0	Import	I + IV	L1 + L2 + L3	kWh	2
–A	2.8.0	Export	II + III	Sum	kWh	
|+A| + |–A|	15.8.0	Combined sum	I + II + III + IV	Sum	kWh	3
+R	3.8.0	Import	I + II	Sum	kvarh	
+R	5.8.0	Import	I	Sum	kvarh	
+R	6.8.0	Import	II	Sum	kvarh	
–R	4.8.0	Export	III + IV	Sum	kvarh	

Remark 1: by vector (Ferraris mode)
Remark 2: by signal values (magnitude summation)
Remark 3: always positive registration (anti-tampering measure)
Sum = vectorial sum of A_{Li} or R_{Li}
L1 + L2 + L3 = magnitude sum
More configuration possibilities can be found in the functional description.

1.8 Instantaneous Values

Instantaneous values are updated every second.

Measured value	Resolution	Start value	Max. value	Accuracy
Voltages L1, L2, L3	1 V		440 V	±1%
Currents I1, I2, I3	0.01 A	0.2 A	99.99 A	±5% for 0.01 to 0.075 I_b ±2.5% for 0.075 I_b to I_{max} (I_b = 5 A, I_{max} = 100 A)
Frequency	0.1 Hz			±1%
Power Factor	0.1			±1%
Power	0.01 kW			±1% (at I > 0.075 I_b)

1.9 Anti-tampering and tamper prevention

E350 meters feature four optional anti-tampering functions:

- Detection of terminal cover opening
- Detection of DC magnetic field
- Sealable access lock to voltage connections
- Detection of Disconnector tampering (Disconnector meters only)

1.10 Disconnector

The ZxF100xB version of the E350 meter is equipped with a disconnector which is controlled via the communication module. Various functions can be implemented:

- disconnection if credit has been used up
- change to minimum power mode if credit has been used up

- disconnection if max. power has been exceeded over a specified time
- others

The disconnector can either be controlled via the AMR module or manually with the disconnector button on the meter’s terminal cover (if parameterised accordingly, see also section 5.1.2 "Disconnector button").

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2 Safety

This section describes the safety information used in this manual, outlines the responsibilities and lists the safety instructions to be observed.

2.1 Safety Information

Attention is drawn to dangers and their level (severity and probability) in this user manual in the following way:

Definition of Danger
For a possibly dangerous situation, which could result in severe physical injury or fatality.

Definition of Warning
For a possibly dangerous situation, which could result in minor physical injury or material damage.

Definition of Note
For general details and other useful information to simplify work.

All safety information also describes the type and source of the danger, its possible consequences and measures to counteract the danger.

2.2 Responsibilities

The owner of the meters is responsible that all persons engaged on work with meters:

1. Are competent and qualified in accordance with national regulations (see ISSA "Guideline for Assessing the Competence of Electrically Skilled Persons").
2. Have read and understood the relevant sections of the user manual.
3. Strictly observe the safety instructions (according to section 2.3) and the operating information in the individual sections.

In particular, the owner of the meters bears responsibility

- for the protection of persons,
- prevention of material damage
- and the training of personnel.

Landis+Gyr AG provides training courses for this purpose on specific equipment; please contact the relevant agent if interested.

2.3 Safety Instructions

The following safety instructions must be observed at all times:

- The meter connections must not be under voltage during installation or when opening. Contact with live parts is dangerous to life. The relevant main fuses should therefore be removed and kept in a safe place until the work is completed, so that other persons cannot replace them unnoticed.
- Local safety regulations must be observed.
- The meters must be held securely during installation. They can cause injuries if dropped.
- Meters which have fallen, must not be installed, even if no damage is apparent, but must be returned for testing to the service and repair department responsible (or the manufacturer). Internal damage can result in functional disorders or short-circuits.
- The meters must on no account be cleaned with running water or with compressed air devices. Water penetrating can cause short-circuits.

2.4 Radio Interference

Possible radio interference in residential environments
This meter is normally a class B product. In combination with some communication modules it can become a Class A product. In a domestic environment, this may then cause radio interference, in which case the user may be required to take adequate measures.

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3 Mechanical Description

3.1 Housing

The internal construction of the meter will not be described here, as the meter is sealed after calibration and verification.

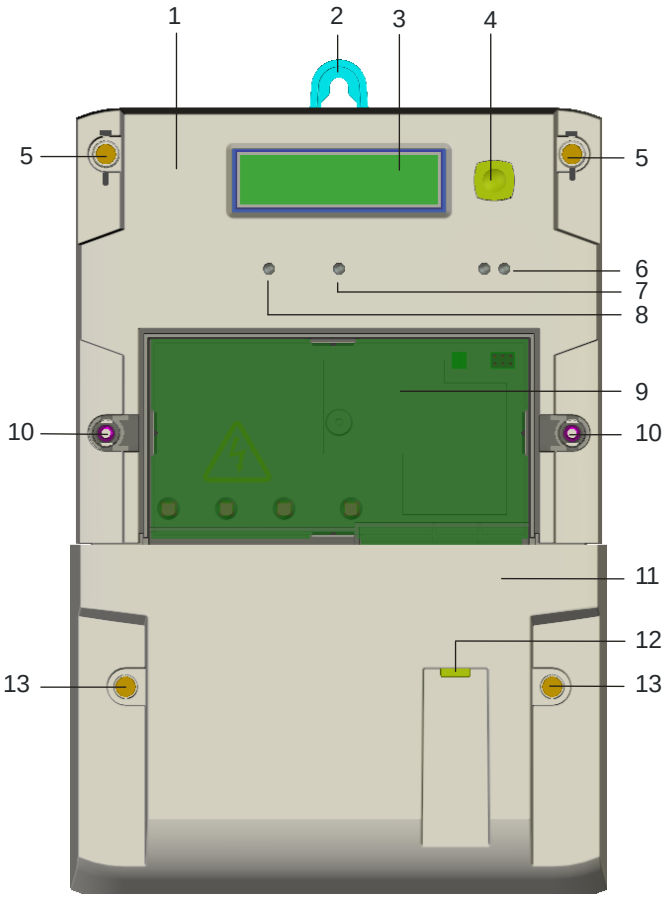

Fig. 3.1 Front view of meter

1 Front cover (face plate with laser marking, for details see Fig. 3.2)
2 Suspension hanger (not inserted for covered mounting)
3 LCD
4 Display button
5 Screw with sealing point (manufacturer or verification seal)
6 Optical interface
7 Test diode active energy (red)
8 Test diode reactive energy (red)
9 AMR Module compartment
10 Screw with sealing point (manufacturer or utility seal)
11 Terminal cover
12 Disconnector button
13 Screw with sealing point (utility seal)

A terminal block with all connecting terminals is located under the terminal cover. On the terminal cover, two sealing points for utility seals prevent unauthorised access to the phase connections and therefore help to avoid unrecorded power consumption.

3.2 Face Plate

The face plate (laser marking on front cover) shows customer specific meter information.

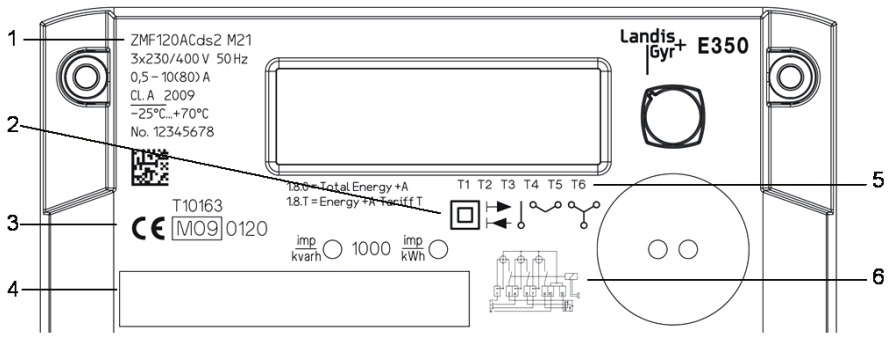

Fig. 3.2 Basic layout of face plate

1 Meter data
2 Double protection insulation symbol
3 Approval symbol, CE conformity symbol
4 Customer No. / Barcode / Ownership designation
5 Active rate
6 Connection diagram

The display key and the display are fully described in section 5.

3.3 Connection Diagrams (examples)

Where to find relevant diagrams
The diagrams relevant for the installation are shown on the meter's face plate or specified otherwise (e.g. inserted in the terminal cover).

ZMF100AC/CC, ZMF100AB/CB

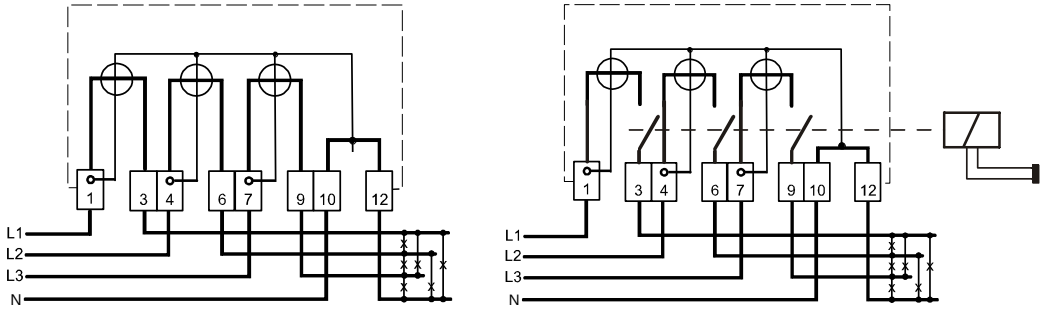

Fig. 3.3 Connection diagram ZMF100xC (left, M-Connection) and ZMF100xB (right, with disconnector)

ZFF100AC/CC, ZFF100AB/CB

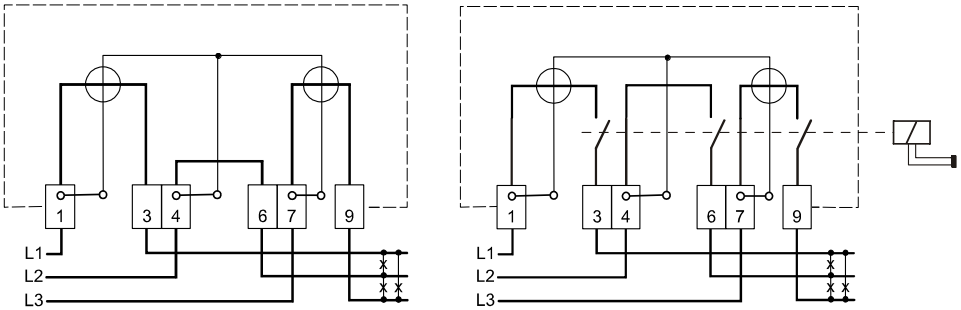

Fig. 3.4 Connection diagram ZFF100xC (left, Aron-Connection), ZFF100xB (right, with disconnector)

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3.4 Dimensions

The meter is either available with a standard terminal cover (see Fig. 3.5) or with an extended terminal cover (see Fig. 3.6)

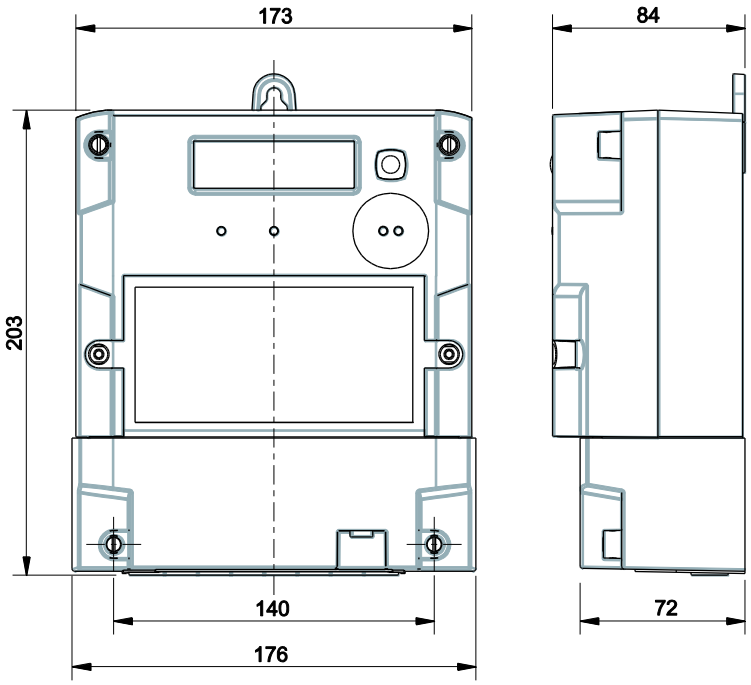

Fig. 3.5 Meter dimensions (version with standard terminal cover)

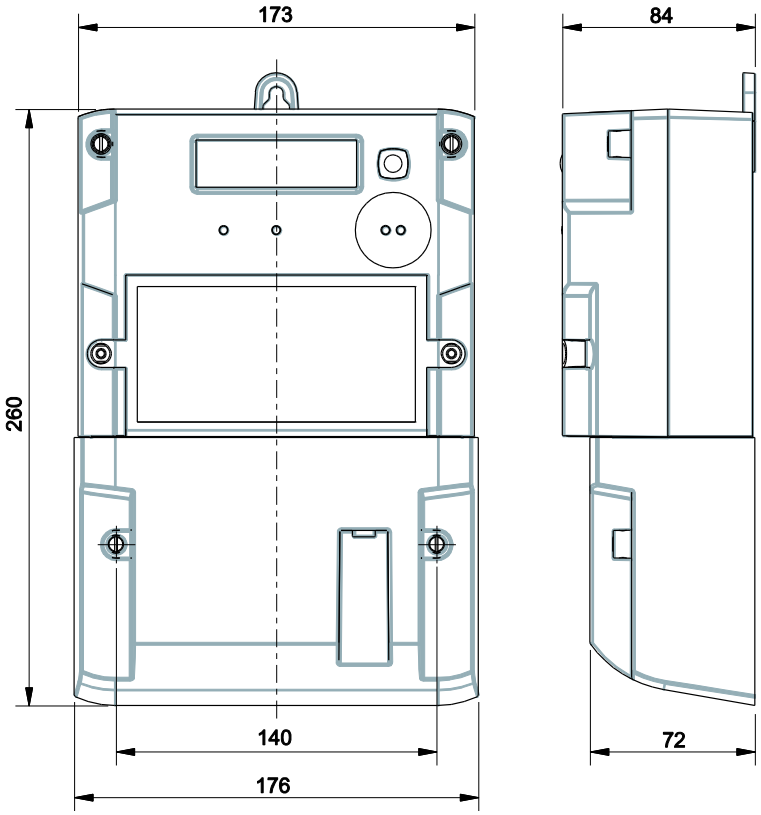

Fig. 3.6 Meter dimensions (version with extended terminal cover)

The meter with extended terminal cover offers increased safety since the phase connecting wires are protected under the terminal cover.

The suspension triangles are identical with both terminal covers. They comply with DIN standards.

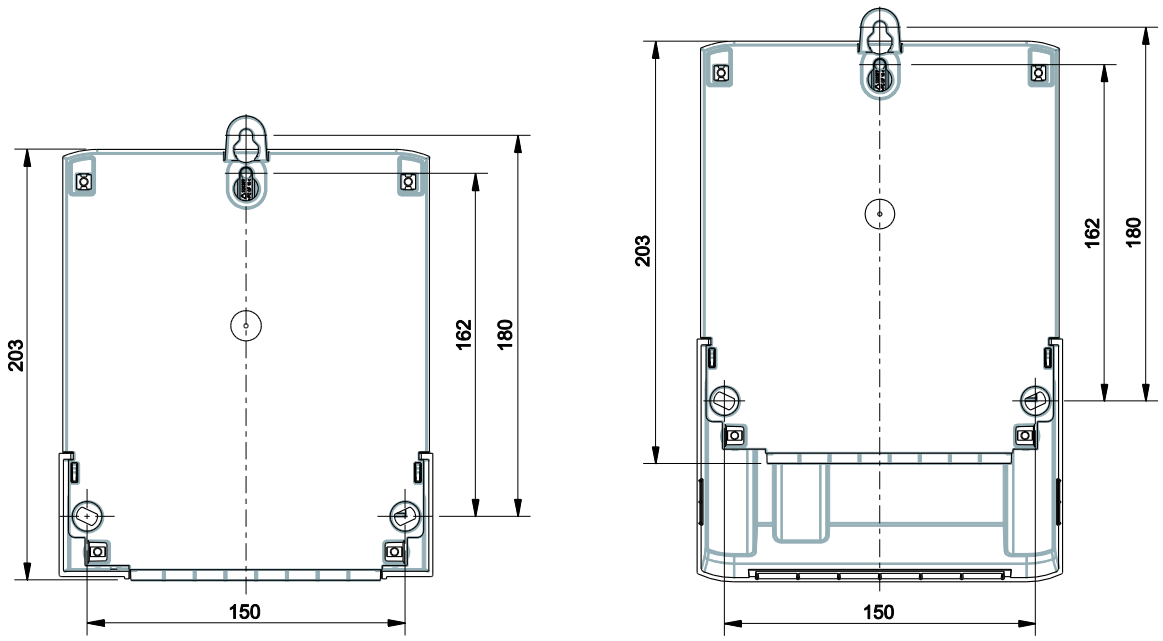

Fig. 3.7 Meter rear view (left with standard terminal cover, right with extended terminal cover)

Terminals are available with an opening diameter of 8.5 mm and 9.5 mm.

Terminals with opening diameter of 8.5 mm and 9.5 mm have the same position on the terminal block.

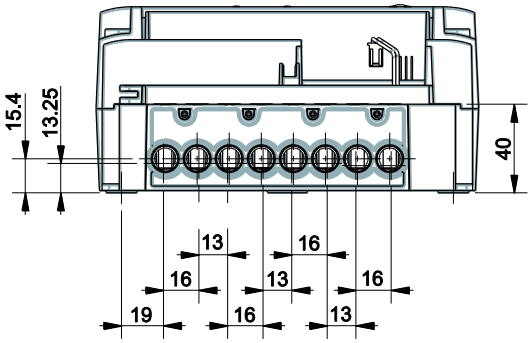

Fig. 3.8 Terminal layout and dimensions

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4 Installation/De-installation

4.1 Mounting the Meter

The meter should be mounted as follows on the meter board or similar device provided for this purpose (see also section *3.4 "Dimensions"*):

1. Find the correct position for the meter. Ensure there are no wires underneath the holes to be drilled.
2. Define the desired form of fixing (open or covered meter mounting).
3. Ensure with a phase tester or universal measuring instrument that the connecting wires are not live.

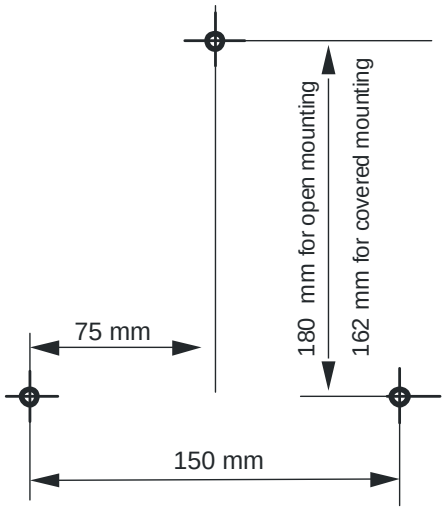

Fig. 4.1 Drilling plan

4. Mark the three fixing points (suspension triangle as shown in the drilling plan Fig. 4.1) on the mounting surface provided.
5. Drill the three holes.
6. Unscrew the meter terminal cover.
7. For open meter mounting insert the meter suspension eyelet – this is supplied in the terminal cover – into the corresponding opening at the rear side of the meter until the suspension eyelet engages (see *Fig. 4.2*).

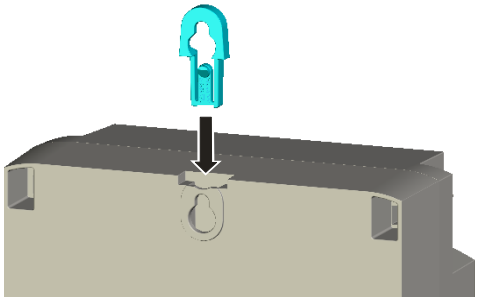

Fig. 4.2 Meter suspension eyelet

8. Fit the meter with 3 fixing screws on the mounting surface provided.

4.2 Connecting the Meter

Remove main fuses before connecting
The connecting wires at the place of installation must not be live when fitting the meter. Touching live parts is dangerous to life. Remove the corresponding main fuses and keep them in a safe place until work is completed, so that they cannot be replaced by anyone unnoticed.

Provide overcurrent protection
For ZxF100xB meters: As the disconnector is not equipped with a thermal and/or short circuit protection device, it needs to be protected with an external fuse or overload switch.
For ZxF100xC meters: As the meter has no internal overcurrent protection and no method of disconnection from the mains, this must be provided by the end installation.

Connecting the phase connection lines

1. Shorten the phase connecting wires to the required length and then strip them.
2. Insert the phase connecting wires into the corresponding terminals (the terminals are numbered as shown in the connection diagram) and tighten the terminal screws firmly (max. torque 3 Nm).

It is recommended to identify the beginning and end of the relevant conductors with a suitable test unit (e.g. buzzer) to ensure that the right consumer is connected to the meter output.

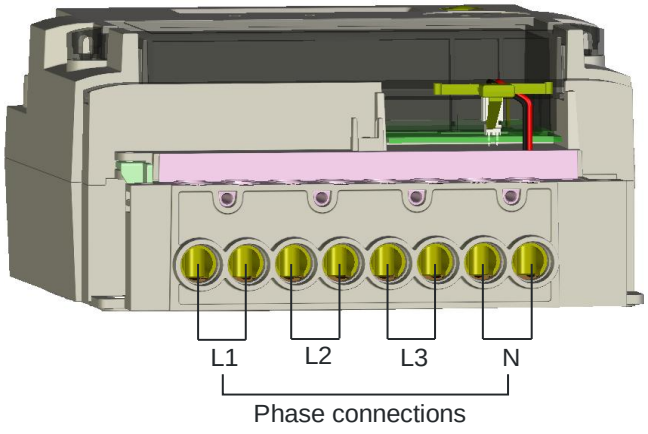

Fig. 4.3 Meter connections

With small conductor cross-sections (e.g. 4 mm^2) the connecting line must be placed in the indentation (stamping) of the current loops, so that it cannot shift sideways when tightening the terminal screws. Ensure that the connecting line remains in the indentation when tightening.

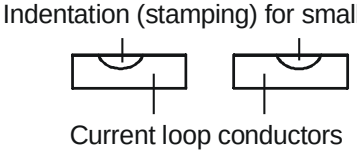

Fig. 4.4 Cross-section through current loop conductor

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Insufficiently tightened screws
Insufficiently tightened screws of the connections can lead to increased power losses at the terminals and therefore to undesirable heating. A contact resistance of 1 mΩ causes a power loss of 6.4 W at 80 A!

Insulate to correct length
Touching live parts is dangerous to life. Shorten the stripped part of the connecting wire if bare wire is visible above the terminal edge.

Do not withdraw connecting wires with closed terminals
Never withdraw connecting wires with the terminal closed, since this could damage the terminal.

4.3 Checking the Connections

Before putting the meter into operation check (and correct, if necessary) the following points to ensure a correct connection:

1. Has the correct meter (identification number) been installed at the measuring point of the relevant consumer?
2. Is the calibration connection closed (sealable sliding piece inserted and sealed)?
3. Are all screws for the phase and neutral connections tightened well?
4. Are all inputs and outputs connected correctly? The house connection or consumer fuse wires must be present at the input (terminals 1, 4, 7), those of the meter to the consumer at the output (terminals 3, 6, 9).
5. Is the neutral conductor connected to terminals 10 and 12? Interchanging of a phase with the neutral could destroy the meter.

Mount the terminal cover after a successful check of the connections, tighten its screws and seal it.

4.4 Commissioning and Functional Check

Do not touch live parts
The main fuses must be inserted to put the meter into operation and for the functional check. Without terminal cover there is a danger of contact with the terminals. Touching live parts is a danger to life.

The installed meter should be put into service and checked as follows:

1. Insert the corresponding main fuses. The meter is on.
2. Check whether the display appears correctly (no error message) and with no load connected that the anti-creep indicators are constantly on.
3. Connect a load and check whether the anti-creep indicator for active energy disappears.
4. Check whether the disconnector (if present) works according to the functionality specified for your application.

4.5 Disconnecting the Meter

Remove main fuses before disconnecting
The connecting wires at the place of installation must not be live when removing the meter. Touching live parts is dangerous to life. The corresponding main fuses should be removed and kept in a safe place until work is completed, so that they cannot be replaced by anyone unnoticed.

For ZxF100xB: **Do not use the disconnector as a main switch for disconnecting purposes!** The meter remains connected to the mains!

Remove the meter from the network as follows:

1. Switch off the voltage. The display goes off.
2. Remove the seal at the terminal cover.
3. Release and remove the terminal cover.
4. Ensure with a phase checker that the connecting wires have no voltage. If there is voltage, remove the main fuses.
5. Remove the connecting wires of the AMR Module, if available.
6. Loosen the terminal screws of the phase and neutral connecting wires with a suitable screwdriver and withdraw the wires from the terminals.
7. Fit a substitute meter as described in section *4.2 "Connecting the Meter*" and the following sections, if necessary.

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5 Operation

5.1 Control Elements

E350 meters have a display button on the front cover and a disconnector button on the terminal cover, if the meter is equipped with a disconnector.

Data acquisition is either made by reading the display or automatic readout via the optical interface. For this purpose, the optical head is placed on the marked position on the front cover of the meter and readout is performed with a handheld terminal (refer to section *5.5 "Data Readout"*).

5.1.1 Display button

The display button is located on the front cover on the right of the LCD.

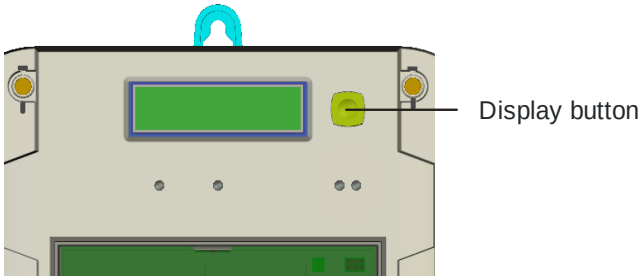

Fig. 5.1 Display button

By pressing the display button, the display mode or the displayed value can be changed (see section *5.2.4 "Display Definitions"*).

5.1.2 Disconnector button

The disconnector button (option) is located on the terminal cover.

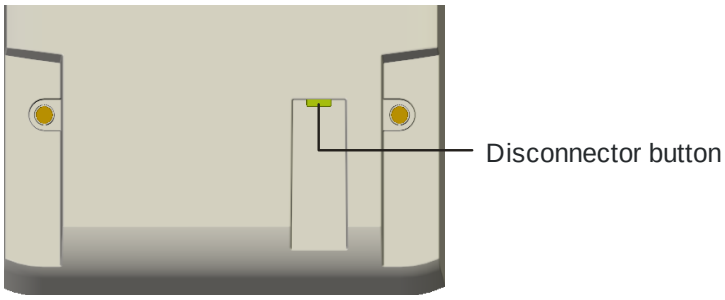

Fig. 5.2 Disconnector button

If the disconnector button is pressed, the disconnector opens and/or closes depending on parameterisation, i.e. a closed disconnector can always be opened with the disconnector button whereas closing an open disconnector needs an additional permission from the meter.

5.2 Liquid Crystal Display (LCD)

5.2.1 Basic Layout

The basic layout shows all indication possibilities of the LCD.

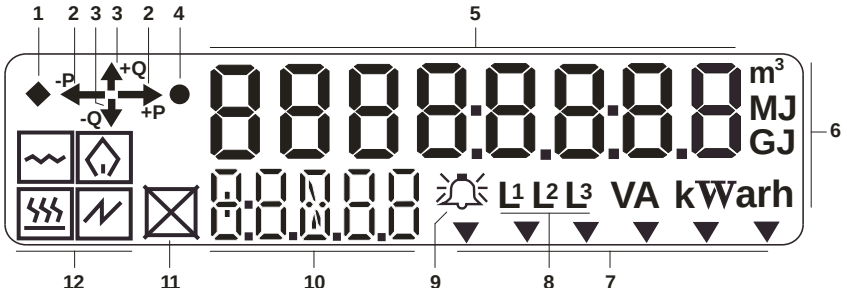

Fig. 5.3 Basic layout of LCD

1 Reactive anti-creep indication
2 Active energy direction indication (+P: import, -P: export)
3 Reactive energy direction indication (+Q: import, -Q: export)
4 Active anti-creep indication
5 Value field (eight 7 segment digits)
6 Unit indications
7 6 arrow symbols for rate indication
8 Phase voltage indications (flashing if rotating field reversed)
9 Tamper alert indicator
10 Index field (five digits with 7, 8 or 11 segments)
11 Disconnect icon
12 Media icons (water, heating, gas, electricity)

5.2.2 Explanation of LCD Elements

For the purpose of this document, flashing LCD segments will be shown in grey colour.

Value field

Up to 8-digit values can be displayed in the value field. The 7 segment digits are able to display numeric data or limited alpha numeric text. Additional decimal points and colons enhance the 7 segment digits. This allows the representation of values with decimal places as well as date and time formats.

Unit indications

VA kWarh m³ MJ GJ

With the unit indications below and on the right side of the value field the following units can be displayed: V, A, kWh, kVah, kVarh, kW, kVa, kVar, m^3, MJ, GJ. The unit displayed indicates which register is being viewed.

Active energy direction indication

Always indicates the sum of the three phases:

+P	positive active energy direction (imported from power company)
-P	negative active energy direction (exported to power company)

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	positive active energy direction, but negative active energy direction of individual phases (arrow -P flashes); only in three-phase four-wire circuit (only with magnitude summation).
	negative active energy direction, but positive active energy direction of individual phases (arrow +P flashes); only in three-phase four-wire circuit (only with magnitude summation)

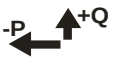
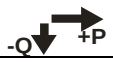
Reactive energy direction indication

Always indicates the sum of the three phases:

	positive reactive energy direction
	negative reactive energy direction
	positive reactive energy direction, but negative reactive energy direction of individual phases (arrow -Q flashes); only in three-phase four-wire circuit (only with magnitude summation)
	negative reactive energy direction, but positive reactive energy direction of individual phases (arrow +Q flashes); only in three-phase four-wire circuit (only with magnitude summation)

Quadrant

Indicates in which quadrant the present measurement is made:

	1st quadrant		3rd quadrant
	2nd quadrant		4th quadrant

Reactive anti-creep indication

◆

The reactive anti-creep indication (a diamond) shows that the kvarh registers have entered anti-creep mode. No energy is flowing through the meter (no reactive energy direction indicator displayed).

Active anti-creep indication

●

The active anti-creep indication (a circle) shows that the kWh registers have entered anti-creep mode. No energy is flowing through the meter (no active energy direction indicator displayed).

Media icons

The media icons represent the medium measured (from left to right water, gas, heating and electricity). The media icon displayed corresponds to group A of the OBIS identification code (see also section *5.2.3*).

The electricity media icon is either ***on*** if data from the internal meter is displayed or is ***flashing*** if data from an external meter is displayed (automatically controlled). The water, gas and heating media icons are also flashing if data from an external source is displayed.

Disconnect icon

This icon indicates that the respective media (represented by the displayed media icon) is disconnected by the disconnector.

Icon ON:	Disconnector open (circuit interrupted)
Icon OFF:	Disconnector closed (circuit closed, current can flow)
Icon flashing:	Disconnector open, can be closed locally (Push Button)

This operation is the preset. The operation will be controlled by the installed module. Please refer to the manual of the module for valid operation mode. Alternatively to this indication a display of the disconnector status can be in the installed module and the display on the LCD can be disabled.

Tamper alert indicator

This icon is switched on when the meter has detected the tamper event parameterised
(either terminal cover, disconnector or strong magnetic field).

Phase voltage indications

The phase voltage indications are switched on if the respective phase voltages are present. It can be selected by parameterisation whether all the phase voltage indications are flashing if the rotating field goes in the wrong direction and/or whether they are flashing if the energy flow is reverse in the corresponding phase.

Arrow symbols

The 6 arrow symbols indicate the active rate as marked on the face plate. It can be parameterised whether the arrow symbol for the active rate is on or flashing.

Index field

Up to 5-digit indices are displayed in this field which define the value in the value field with groups **C, D and E** of the OBIS identification code (see following section).

Examples:

1.8.0 indicates that the status (group D = 8) of total (group E = 0) active energy import of all phases (group C = 1) is displayed in the value field.

0.9.1 indicates that the local time is displayed in the value field.

5.2.3 Displaying OBIS Codes

For OBIS (Object Identification System) the structure **A-B:C.D.E.F** applies. The individual groups have the following significance:

A Defines the medium, e.g. electricity, gas, heat or water-related data. **Group A is represented with the media icons.**

B Group B is not shown on E350 meters (only channel 1 available).

C Defines the measured quantity, the abstract or physical data items related to the information source concerned, e.g. active power, reactive

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power, apparent power, power factor, current or voltage.

D Defines types, or the result of the processing of physical quantities according to various algorithms. The algorithms can deliver energy and demand quantities as well as other physical quantities.

E Defines the rates in use. For abstract data or for measurement results without rates, this value group can be used for further classification.

F Group F is not shown on E350 meters.

Representation example

OBIS identification code **1-1:31.7.1.0** (line current in phase L1) is represented as follows on the display:

Group A of the OBIS identification code is represented by the media icon for electricity, groups B and F are not displayed and groups C to E are represented as index value 31.7.1.

The line current in phase L1 is indicated with 25.24 A.

The active energy direction arrow +P, the phase voltage indications L1, L2 and L3 and the arrow symbol of the current rate are also displayed.

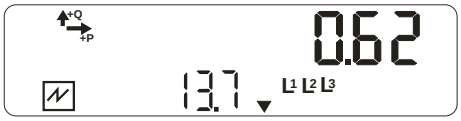
5.2.4 Display Definitions

The meter can show various displays. Here are some examples.

Note
The number of digits and decimal places displayed can be parameterised (also whether leading zeros are to be displayed).
The following examples show different settings.

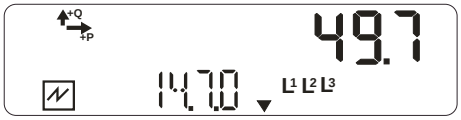
Total active energy import

Total power factor



Total reactive energy import

Mains frequency

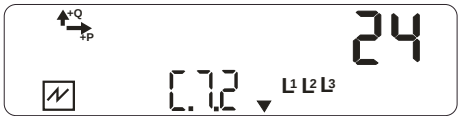


Active energy import rate 1

Status code

Active energy export rate 2

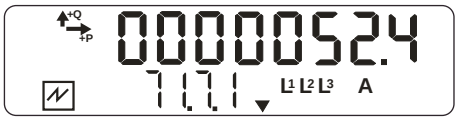
Phase fail counter L1



Line voltage L1

Manufacturer identification number

Line current L3



Water consumption

Total active energy

Heat consumption

Reactive energy L1

Gas consumption

5.2.5 Display Sequence

The previous section showed in detail the possible displays. The display sequences shown on any specific customer's product are set through parameterisation at the factory.

There are two display sequences:

- Normal display sequence (NDS)
- Certification display sequence (CDS) for service purposes

The normal display sequence can include up to 31 displays, the certification display sequence up to 63 displays (defined by parameterisation).

The parameters which have an influence on the display sequence must be defined in the configuration process.

These items are:

- Leading zeros can be enabled/disabled for registers
- Energy register displays can be defined with an integer part of 6 digits (in exceptional cases 5) and with 0, 1, 2 or 3 decimal places. Max 6 significant digits (left of the decimal point) are allowed. Max. 8 digits including decimal places are available.
- Only 6 integer digits are allowed for meters according MID.
- Active rate indication can be enabled or disabled
- Flashing decimal point to indicate that the meter is in the certification display sequence

Power up

During power up of the meter the type and software version of the meter is displayed for 10 seconds.

The display contains:

- In the main field "100" and the characters to define whether it is an active or a combi meter respectively a meter with or without disconnector, e.g. 100 AB, 100 AC, 100 BC, 100 BB.
- In the index field the software version,
  e.g. **21** for version M21 or with alternative format: **2300** for M23.0.0.

Then the certification display sequence appears and scrolls through the list items (Autoscrolling only after power up). If start-up time for certification mode display is zero, the display starts directly with the main display list.

Certification display sequence (CDS)

The certification display sequence allows tests to be carried out by allowing registers to be displayed at higher resolutions, and is accessed when the meter is first powered up, or on a **long press** (more than 5 seconds) of the display button.

The items in the certification display sequence (maximum 63) can be scrolled through with **short presses** (less than 5 seconds) of the push button. When the end of the sequence is reached, auto-cycling of the normal display sequence will start. Auto-cycling of the normal display sequence will also start if the button isn't pressed for a period, configurable at manufacturing, of between 0 and 30 minutes (default 30 min.), or on a **long press** of the push button.

Normal display sequence (NDS)

The number of displays (max. 31) and their sequence (auto scroll) can be parameterised, also the display duration for the items (between 1 and 15 seconds). After the last display in the auto scroll sequence, status messages (e.g. error, tamper, low voltage) are displayed, and then it starts again. The normal display sequence can be split by parameterisation into a limited auto scroll part (e.g. the 5 most important displays) and an only manually accessible part (the remaining displays). If the number of displays in the auto scroll part is set to 1, auto scroll is switched off and the first display of the normal display sequence is displayed continuously.

Up to 12 displays, under the control of the AMR module, can be included in the normal display sequence.

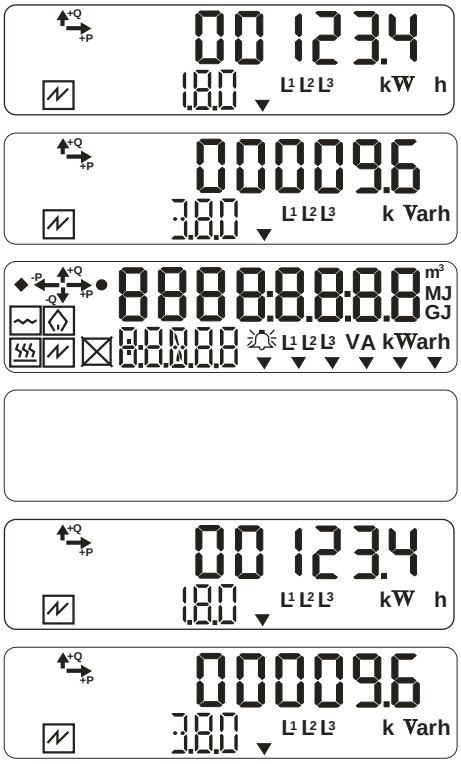
A **short press** moves the display to the next item in the sequence. Repeated short presses will scroll through to the end of the sequence, then "End" is displayed after which auto-cycling is resumed. Auto-cycling will also be resumed after a configurable number of seconds from when the button was last pressed. This "auto-cycle timeout" value can be configured at manufacturing to between 5 and 60 s (default 30 s).

A **long press** will access the *certification display sequence*.

Example

The following table shows a simple meter normal display sequence configuration. The value of the total active energy import register is assumed to be 000123456 Wh and that of the total reactive energy import register 000009876 varh. The registers are set to show 6 digits with 1 decimal place. The leading zeros are not suppressed.

Displayed value
Total active energy import
Total reactive energy import
Display check (all segments on)
Empty display (all segments off)

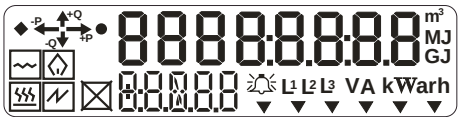


etc.

The meter first shows the total active energy import register as 00123.4 kWh, followed by the reactive energy import register as 00009.6 kvarh and all segments on and then all off. The display duration for each display can be set between 1 and 10 seconds, but not individually. This sequence is repeated until the meter is switched off or the installation sequence entered.

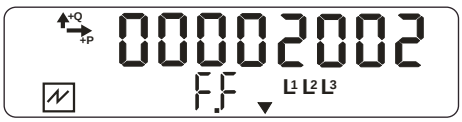
5.2.6 Display Check

During the display check all segments of the display are on. Especially the index and value fields should be checked for missing segments.



5.2.7 Error Display

An error display can be included in a display sequence, but it also automatically turns up in case of a malfunction. The error number is based on a 32 bit value in which each bit, if set, indicates a particular error condition. In the following error display the error number "00002002" is composed of the two errors "00000002" (Failed communication with the MMI device more than 32 times) and "00002000" (Calibration value failed checksum).



The error messages are described below.

5.2.8 Text messages on display

It is possible for the module to show information on the meter display. Possible items include Ids of connected devices, time. For this, the value and the index fields can be used. This information is available in the module documentation.

The following characters can be used in text messages:

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Zeichen	LCD
<SPACE>	
– (minus)	-
_ (underscore)	_
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9

Zeichen	LCD
A	A
B	b
C	C
D	d
E	E
F	F
G	G
H	h
I	i
J	J
K	_
L	L
M	n

Zeichen	LCD
N	n
O	o
P	P
Q	q
R	r
S	S
T	t
U	u
V	U
W	U
X	_
Y	y
Z	2

Display variations
Some characters might be displayed differently, depending on module and meter version.
Characters which can't be represented with the 7-segment-display will be replaced by an underscore (there are also meter versions with a slightly different character set. E.g. the characters that cannot be shown are represented with a lower "o").

5.2.9 Meter display list – available items with OBIS codes

OBIS code	Item
F.F	Error Code (always first in the list)
C.1.0	Meter identification (8 character string)
0.0	Customer identification (16 character string) (Readout)
0.0.1	Customer identification (characters 1-8) (Display)
0.0.2	Customer identification (characters 9-16) (Display)
C.1.1	Manufacture identification (8 character string)
C.90.1	IEC-address of meter
1.8.0	Total active energy import
1.8.X	Active energy import rate X (X = 1…6)
2.8.0	Total active energy export
2.8.X	Active energy export rate X (X = 1…6)

OBIS code	Item
3.8.0	Total reactive energy import
3.8.X	Reactive energy import rate X (X = 1…6)
4.8.0	Total reactive energy export
4.8.X	Reactive energy export rate X (X = 1…6)
32.7.0	Line voltage L1 or L12
52.7.0	Line voltage L2
72.7.0	Line voltage L3 or L32
31.7.1	Line current L1
51.7.1	Line current L2
71.7.1	Line current L3
36.7.0	Active energy L1
56.7.0	Active energy L2
76.7.0	Active energy L3
16.7.0	Total active energy
33.7	Power factor L1
53.7	Power factor L2
73.7	Power factor L3
13.7	Total power factor
151.7.0	Reactive energy L1
171.7.0	Reactive energy L2
191.7.0	Reactive energy L3
131.7.0	Total reactive energy
14.7.0	Mains frequency
82.8.2	DC field detection counter
82.8.1	Terminal cover removal counter
C.5.0	Status code (see section 5.5.3)
C.7.0	Power off counter
C.7.1	Phase fail counter L1
C.7.2	Phase fail counter L2
C.7.3	Phase fail counter L3
0.2.0	Software version
0.2.1	Parameter identification
C.2.0	Number of parameterisations
0.2.1	Scheme ID
All off	Blank display
All on	All segments on
5.8.0	Reactive Energy Q1
6.8.0	Reactive Energy Q2
7.8.0	Reactive Energy Q3

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OBIS code	Item
8.8.0	Reactive Energy Q4
9.8.0	Apparent Energy {+kVAh} (Q1+Q4)
10.8.0	Apparent Energy {-kVAh} (Q2+Q3)
15.8.0	Active Energy - Absolute Value [|+A|+|-A|] {+kWh}
16.8.0	Active Energy - Absolute Value [|+A|-|-A|] {+/-kWh}
128.8.0	Active Energy - Sum Phase Absolute Value ['SUM' |A Li|] {+kWh}
130.8.0	Reactive Energy - Absolute Value [|+R|+|-R|] {+kvarh}
131.8.0	Reactive Energy - Absolute Value [|+R|-|-R|] {+/-kvarh}
132.8.0	Reactive Energy - Import [+R(Q1+Q4)] {kvarh(+)}
133.8.0	Reactive Energy - Export [-R(Q2+Q3)] {kvarh(-)}
36.7	Phase R kW
56.7	Phase S kW
76.7	Phase T kW
16.7	Total (R+S+T) kW
151.7	Phase R kVar
171.7	Phase S kVar
191.7	Phase T kVar
131.7	Total (R+S+T) kVar
	4 Energy efficiency items (see section5.2.11)
	Module data 1 - 12
	End of list

5.2.10 Display status messages

Depending from configuration the following messages can appear on the end of a display list:

td: **t**erminal cover tamper **d**etection

mfd: **m**agnetic **f**raud **d**etection

btd: **b**reaker **t**amper **d**etection

rEd: **Re**verse Energy has been **d**etected

5.2.11 Energy efficiency items in the meter display

If configured appropriately the display can list 4 new items intended to allow the consumer to easily monitor energy flow:

Item	Display	Content	Remarks
Import Energy Meter	St1	Import Energy 1.8.0	Resettable
Export Energy Meter	St2	Export Energy 2.8.0	Resettable
24 Hour Energy Consumption	24 h	Import Energy 1.8.0 over last 24 h	Refresh every 5 min
1 Week Energy Consumption	1 w	Import Energy 1.8.0 over last week	Refresh every 1 hour

The resolution of these 4 displays is 1 W.

The Import and the Export energy Meter values (St1 and St2) can be reset by applying a long button press whilst the register value is being displayed on the meter.

During power outage registers St1 and St2 are reset. These both registers start after recover of power with the values of the energy registers of import or export energy (St1: import, value register 1.8.0; St2: export, value register 2.8.0)

Time during power outages is not included in the elapsed time measurements of the registers “24 Hour Energy Consumption” and “1 Week Energy Consumption”.

e.g. For the 24 h register assume registration for 5 hours followed by 1 hour power outage. Then completion of the 24 h registration will complete 19 hours following the end of the outage (5 h + 19 h = 24 h)

After resumption of power following an outage, the registers “24 Hour Energy Consumption” and “1 Week Energy Consumption” will display “0” until the first refresh occurs (i.e. after 5min and 1 hour respectively).

5.2.12 Error descriptions E350 Series 1 and Series 2

"> C150" in the following table
Clear method C150: Meters can be cleared either using the formatted write command C150 or by power cycling the meter. If the problem persists, contact Landis+Gyr Service. (Errors of persisting problems cannot be cleared.)

E350 series 1			**E350 series 2** (Readout flag like E350 series 1)		
Display Number	**Readout Flag**	**Description**	**Display**	**Description**	**Further Details and Clear Method**
01	04	Read from or write to EEPROM failed.	00 02 00 00	Error accessing EEPROM.	**> C150**
02	40	Power save structure read from EEPROM is corrupt when the meter is powered up.	00 00 40 00	Power Fail Data failed checksum.	Some values, e.g. phase fail counts, are saved to EEPROM when a power fail occurs. These values are restored at power up and checked (checksum). This error is generated if the calculated checksum doesn’t agree with the stored checksum. **> C150**

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E350 series 1			**E350 series 2** (Readout flag like E350 series 1)		
Display Number	**Readout Flag**	**Description**	**Display**	**Description**	**Further Details and Clear Method**
03	08	Checksum of calibration data and serial number is incorrect. Calibration data read from EEPROM is corrupt.	00 00 20 00	Calibration value failed checksum.	This error will persist until either the data in the calibration and channel configuration areas of the EEPROM are corrected. Or the manufacture command is sent to the meter to re-calculate the checksum and save it to EEPROM. Contact L+G Service for support.
04	20	Register values (all backups) read from EEPROM are corrupt.	00 40 00 00	Error restoring energy registers. *(Unable to read from EEPROM)*	This error is only set after a power cycle if the meter is unable to successfully read the register values saved in EEPROM. **> C150**
			00 00 80 00	Failed checksum when restoring registers from EEPROM. *(No backup of registers available.)*	This error is only set after a power cycle if the meter is unable to successfully restore the register values saved in EEPROM due to a checksum error. Once this error has occurred the register values must be assumed to be incorrect, even if the error indication is cleared. Contact L+G Service for support.
05		At least one register value read from EEPROM was corrupt, but a non-corrupt one was available.		*No corresponding error.*	
06	02	8 successive communication attempts to the same MMI have failed.	00 00 00 02	More than 32 consecutive attempts to communicate with, or initialise the MMI devices have failed.	**> C150**
07		At least one MMI had corrupted parameters when it was checked.		*No corresponding error bit, but a count, saved on power fail, is held for each phase, of the number of times a corrupted parameter has been detected.*	

E350 series 1			E350 series 2 (Readout flag like E350 series 1)		
Display Number	**Readout Flag**	**Description**	**Display**	**Description**	**Further Details and Clear Method**
08		Cyclic redundancy check of power supply		**Not applicable.** Specific to Flex 1 hardware.	
		No corresponding error.	00 00 00 01	Insufficient time to complete power failure.	When the meter is working correctly key values are saved to EEPROM. If the meter was unable to complete the saving of these values (power cut or watchdog reset), this error will be indicated when the meter next powers up. **> C150**
		No corresponding error.	00 80 00 00	Error saving energy registers.	This error is set if the meter cannot save register values to EEPROM. **> C150**

If more than one error is detected the error codes are added. If e.g. all errors of the above list occurred simultaneously the error code would be the sum of all error codes = 00C2E003 (note that the error code is a hex value).

Note
The formatted write command C150 only clears the error flags, it does not eliminate the error.

Byte 4								Byte 3								Byte 2								Byte 1							
8	4	2	1	8	4	2	1	8	4	2	1	8	4	2	1	8	4	2	1	8	4	2	1	8	4	2	1	8	4	2	1
not used	not used	not used	not used	not used	not used	not used	not used	Error saving energy registers.	Error restoring energy registers.					Error accessing EEPROM.		Failed checksum when restoring registers.	Power Fail Data failed checksum.	Calibration value failed checksum.												More than 32 consecutive attempts	Insufficient time to complete power failure.

Each digit of the error code represents four errors (i.e. four bits of the error register). The status of the four bits is shown in hexadecimal code i.e. the single digits may show values between 0 (no error message set) and F (all four error messages set).

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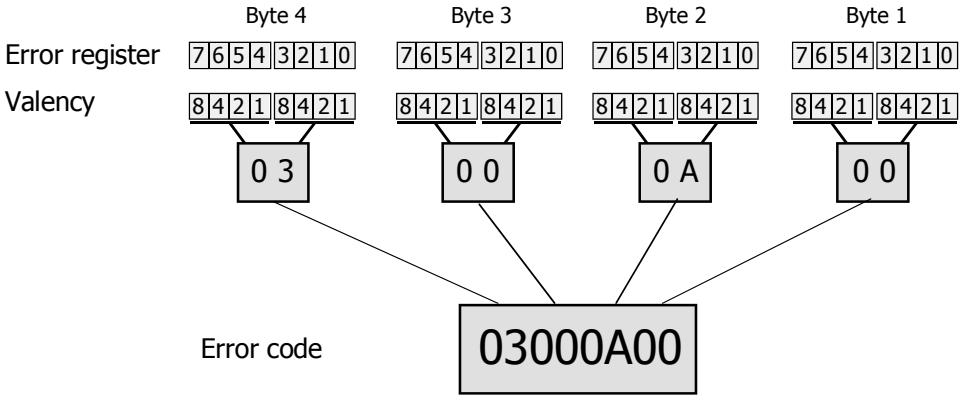
Error codes are added
As all errors are shown in hexadecimal code, a single error can appear in various ways depending on the presence of other errors.

Example:

Two errors are shown as: FF **01**00**02**00
Another two errors occur: FF **02**00**08**00
The register reads: FF **03**00**0A**00



5.3 Optical Test Outputs

The test diodes – one for active and one for reactive energy – are used for meter testing. They transmit visible red pulses equivalent to the currently measured value. The number of pulses per time unit depends on the meter constant (as stated on the face plate). When registering energy the test diodes will flash at a rate of 1 pulse per Wh or VArh of energy recorded. The pulse width is 10 ms.

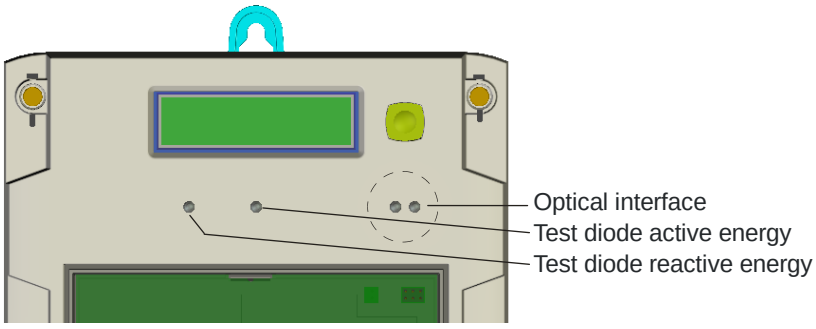


Fig. 5.4 Optical test outputs and optical interface

5.4 Optical Interface

All meters have an optical communications port (see Fig. 5.4). If the AMR module supports this function, both meter and module can be accessed via optical port. In this case, the AMR module has to be addressed.

The optical interface allows reading the meter's registers and identity in the field using a suitable device (Hand Held Terminal or PDA). The readout list is in full accordance with the provisions of IEC62056-21. The optical port is normally closed, a wake up string is sent to the meter, which activates the readout list.

Access to module over optical port

Access to module over optical port of meter is possible with

/?xxxxxxxx7214!

where xxxxxxxx is the meter number.

Opening 7214 → 7 bit, even parity, 1 stop bit, 4800 bps

This can be used to read out the module over the optical meter interface or to set the TOU-table of the module.

5.5 Data Readout

The power supplier can read the meter data, particularly the energy consumption, locally in two ways:

- Reading the meter's LCD. Only the data shown in the display list can be recorded.
- Automatic data readout via the optical interface with the aid of an AMR Module (e.g. hand held terminal T3000). Further data are then accessible depending on the parameterisation (total registers etc.). Log corresponds to the provisions of IEC62056-21, a communication standard for meters.

5.5.1 IEC 62056-21 Mode C

The meter supports IEC 62056-21 mode C-a. This enables the reading of data from the meter in the data readout mode. After an initial sign-on sequence, the meter transmits its data to the HHT. This consists of a number of items which are set in the configuration. Each item is sent in ASCII with OBIS (IEC 62056-61) identifiers. Each identifier is on a separate line (separated by carriage return and line feed characters CRLF) and follows the format Identifier (value*units).

The maximum transmission rate is 9600 bps. The response message identifies the software version and the IEC 62056-21 baud rate mode used.

The meter provides also a manufacturer specific mode C-C, which delivers only a part of the read out list (start and end item are configurable during production). This can be used for fast read out for frequently required values.

5.5.2 Readout Configuration

The readout items, their order in the list, along with the number of decimal places for the registers, are specified in the configuration. The register sizes are fixed at 6 integer digits and have up to 3 decimal places. This is independent on the display configuration.

The readout list (similar to the display list) consists of a number of specified items. The customer specifies the readout sequence. This sequence is set at the factory. All items are identified with OBIS codes when read out.

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Readout and display items

The items that can be placed in the readout list (in any order except for "Error code" which is always first in the list) are listed in section 5.2.9 "Meter display list – available items with OBIS codes" on page 34. Most of these items can be included in the read out list.

Readout error code (F.F)

The error code consists of 8 bits and describes the following:

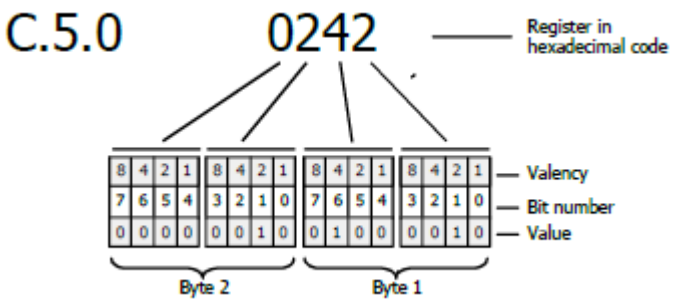
Bit number	Allocation
0	Not used
1	MMI initialisation or communications failure
2	Error accessing EEPROM
3	Calibration data is corrupted
4	Not used
5	Error restoring energy registers
6	Data saved to EEPROM on power fail is corrupted
7	Not used

Valid for readout with E35C-modules! For other modes other codes could be delivered e.g. equal to error display values.

5.5.3 Readout Status Code (C.5.0)

The E350 devices feature along with universal device status symbol showed on display also a status register which shows the current status of the device. The readout status register C.5.0 consists of 16 bits (2 bytes) and describes the following:

Bit number	Allocation
0	Reverse detect
1	Creep flag
2	L1 phase fail flag
3	L2 phase fail flag
4	L3 phase fail flag
5 to 7	Active rate (coded): ***bit 7 bit 6 bit 5 active rate*** *0 0 0 rate 1* *0 0 1 rate 2* *0 1 0 rate 3* *0 1 1 rate 4* *1 0 0 rate 5* *1 0 1 rate 6*
8	Strong DC field detected
9	Terminal cover removed
10	Disconnector state (0 = open, 1 = closed)
11 to 15	reserved



The status register is available to be read via communication (public or optical) or displayed on LCD in hexadecimal form.
Some meter configuration contains also a special code which is 4 bytes long.

This code is described in the Functional description.

All reserved or not used bits are set to 0 by default.

5.5.4 Data Readout Procedure via Optical Interface or AMR Module

1. Start the AMR Module (according to the associated user manuals).
2. Connect the cable of the reader head to the Hand Held Terminal.
3. Place the reader head in the marked position on the face plate of the meter. The reader head is held magnetically.
4. Start the data readout with the Hand Held Terminal.
5. Remove the reader head from the meter again after readout.

Readout list (example)

The data read out are recorded in the form shown below. The scope and sequence of values in the readout list is determined by parameterisation.

Info flow	Readout list		Significance
→	/?! $^{C_R L_F}$		Opening string (initial sign on)
←	/LGZ0ZMF100AC.MXX$^{C_R L_F}$		Unit recognition for the specific manufacturer (no identification of data; MXX: SW version)
→	<ACK>0Z0 $^{C_R L_F}$		Acknowledgement; Z: Transmission rate
←	<STX> F.F(00000000)$^{C_R L_F}$		Start of text, Error message
←	C.1.1(0000000074892473) $^{C_R L_F}$		Meter identification number 1
←	1.8.0(000065.3*kWh) $^{C_R L_F}$		Total active energy import
←	2.8.0(000003.5*kWh)$^{C_R L_F}$		Total active energy export
←	1.8.1(000021.5*kWh)$^{C_R L_F}$		Active energy import rate 1
←	1.8.2(00043.8*kWh)$^{C_R L_F}$		Active energy import rate 2
←	2.8.1(000001.5*kWh)$^{C_R L_F}$		Active energy export rate 1
←	2.8.2(00000.0*kWh)$^{C_R L_F}$		Active energy export rate 2
←	C.5.0(03)$^{C_R L_F}$		Status code (L2 phase fail flag)
←	!$^{C_R L_F}$<ETX><BCC>		End of text, Checksum

Fig. 5.5 Example of readout list

<ACK>, <CR>, <LF>, <STX>, <ETX>, <BCC> ASCII character not visualised in the data readout list.

The code Z in the data readout acknowledge string identifies the required transmission rate for the data to follow:

Code Z	Transmission rate
0	300 bps
1	600 bps
2	1200 bps
3	2400 bps
4	4800 bps
5	9600 bps

5.5.5 Addressability of meter

The meter monitors every communication request received over the optical port or the AMR-interface. The AMR-interface can be controlled by various inputs from the module (e.g. cs-interface-input).

With SW-versions M23 or higher the meter will react to the communication request only under either of the following conditions:

- If the request contains no address,
- If the address matches with the address of the meter.

The address of the meter is preset to the serial number of the meter.

For SW-versions prior to M23 the meters reacts only if the request contains no address.

6 Service

6.1 Operating Faults

If the LCD is not readable or the data readout does not work, the following points should be checked first:

1. Is the mains voltage present (main fuses intact)?
2. Is the maximum permissible ambient temperature not exceeded?
3. Is the optical interface and/or the liquid crystal display clean (not scratched, painted over, misted over or soiled in any way)?

If none of the points listed is the cause of the fault, the meter should be disconnected, removed and sent to the responsible Landis+Gyr service centre (according to section 6.3 "Repairing Meters").

6.2 Error Codes

For a complete list of error messages see section 5.2.12 "Error descriptions E350 Series 1 and Series 2" on page 37.

Non-persistent error messages are reset at the next readout. Persistent error messages cannot be reset in the field. A meter showing a persistent error message must be considered unsafe for further use and the next steps have to be discussed with a Landis+Gyr Service Centre (see section 6.3).

6.3 Repairing Meters

The following procedure should be adopted if a meter repair is necessary:

1. If installed, remove the meter (see section 4.5) and fit a substitute meter.
2. Describe the error found as exactly as possible and state the name and telephone number of the person responsible in case of inquiries. Please also state serial no. and complete type designation no.
3. Pack the meter to ensure it is not damaged during transport. Use the original packing, if available. Do not enclose any loose components.
4. Send the meter to an authorised service centre.

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7 Maintenance

The meter is maintenance-free. The following points should be regularly checked:

- Is the meter dry and clean (particularly display and optical interface)?
- Is the meter in operation and serviceable (displayed data reasonable)?
- Are all seals undamaged?
- Is there an error recorded based on periodical internal self tests since the previous check (check on the display or readout list)?
- Have the values of the energy registers changed within reasonable limits since the last data readout (no unauthorised manipulations)?

Continue with section *6.3 "Repairing Meters"* in case of irregularities.

7.1 Meter Testing

The meters are calibrated during manufacturing. A later recalibration is not possible. Meter tests should be performed at periodic intervals according to the valid national regulations (either on all meters or on specific random samples). For this purpose, the meters must be removed as described in section *4.5 "Disconnecting the Meter"* and replaced by a substitute meter for the duration of the test.

7.1.1 Higher Register Resolution

The meter features a *certification display sequence* which allows registers to be displayed with 3 decimal places. See *5.2.5 "Display Sequence"*.

This sequence is entered by pressing the display button for more than 5 s. It is left again if the display button is not pressed for a time between 0 and 60 minutes (default 30 minutes) determined by parameterisation.

Display example

This mode is used for accelerated product certification which can now be done with 0.5 kW in about 2 minutes. It is indicated by a flashing decimal point.

7.1.2 Measuring Times

For technical reasons higher measuring deviations can occur during short-term measurements. It is therefore recommended to use sufficiently long measuring times in order to achieve the required accuracy.

Table of required measuring times:

ZMF
U_n=230 V

	Measuring uncertainty 0.2%			Measuring uncertainty 0.1%		
Current [A]	3 P cosφ=1	1 P 1	3 P 0.5	3 P cosφ=1	1 P 1	3 P 0.5
0.2	25 s	70 s	90 s	90 s	4.5 min	6 min
0.5	20 s	20 s	20 s	20 s	45 s	60 s
>= 1	20 s	20 s	20 s	20 s	20 s	20 s

3 P = universal
1 P = single-phase

ZFF
U_n =230 V

	Measuring uncertainty 0.2%			Measuring uncertainty 0.1%		
Current [A]	3 P cosφ=1	1 P 1	3 P 0.5	3 P cosφ=1	1 P 1	3 P 0.5
0.2	42 s	3 min	3 min	3 min	12 min	11 min
0.5	20 s	30 s	27 s	30 s	2 min	2 min
1	20 s	20 s	20 s	20 s	30 s	30 s
>= 2	20 s	20 s	20 s	20 s	20 s	20 s

7.1.3 Optical Test Outputs

The red test diodes are positioned on the face plate.

LED for active energy: It supplies pulses with a value of 1 Wh of the import or export energy measured. This corresponds to a meter constant of 1’000 imp/kWh. For meter testing purposes, only the rising edge is decisive.

LED for reactive energy: The LED for reactive energy works similar, but with values of 1 varh and a meter constant of 1’000 imp/kWh.

7.1.4 Connection to a Meter Testing Device

To test the meter, connect it to a dedicated testing device.

The meter uses a voltage jumper whereby a spring contact connects the voltage circuit of the meter to the phase terminal. By inserting a contact pin of 2.5 mm diameter, the voltage and current circuits of the meter are separated and the test voltage is connected via the contact pin. See *Fig. 7.1*.

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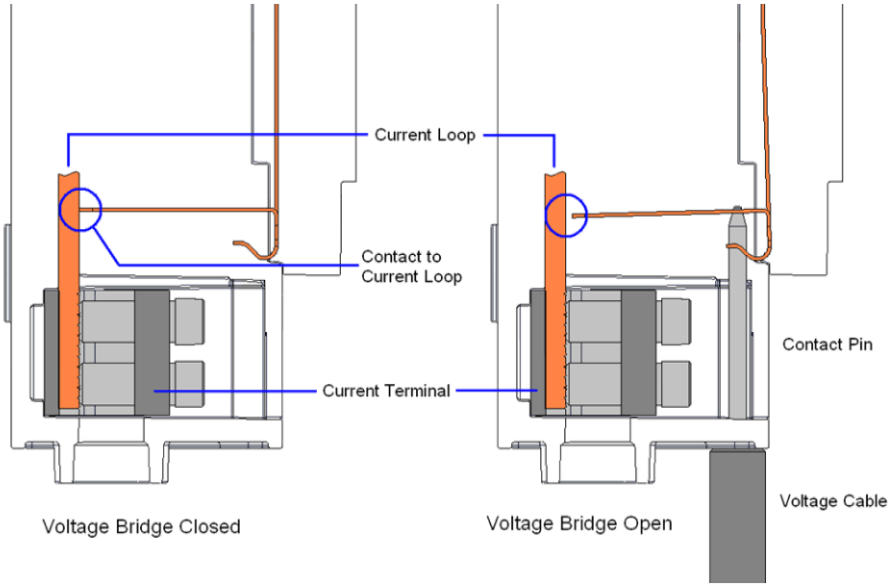

Fig. 7.1 Voltage jumper with test voltage connection

Procedure:

1. Connect the meter to the terminals of the testing device as shown in the meter connection diagram and according to the usual testing methods. Remove the access lock sliding piece, if present.
2. To connect the test voltage, use a connecting cable with a contact pin of 2.5 mm diameter and 40 mm length (± 1 mm). Insert this pin in the opening provided on the front of the terminal block, right above the measuring terminals.

Keep voltage cables free from voltage when inserting
Touching live contact pins can be fatal.

3. After testing, remove the cable (voltage-free!) from the terminal cover. The spring closes the contact and the voltage is connected again. Insert the access lock sliding piece again, if necessary, and seal it.

7.1.5 Creep Test

A test voltage U_p of 1.15 U_n is used for the creep test (no-load test) according to IEC 62053-21 (e.g. U_p = 265 V with U_n = 230 V).

Procedure:

1. Disconnect the meter from the mains for at least 10 seconds.
2. Switch on the test voltage U_p and wait approx. 10 seconds. Both the active (circle) and the reactive (diamond) anti-creep indication must now be permanently on. The energy direction indicators are off.

7.1.6 Starting Test

Procedure:

1. Apply a load current of 0.1% of the base current I_b or, for MID-meters, of the reference current I_{ref}, e.g. 10 mA with I_b=I_{ref}=10 A, and the voltage U_n (three-phase in each case). The meter must remain in creep.

2. Increase the load current to 0.5% I_b (for MID: to 0.5% I_{ref}) (i.e. 50 mA with $I_b = I_{ref} = 10$ A). The energy direction arrow must appear within 10 seconds and both anti-creep indications must disappear. The optical test output for active energy must start to flash.

7.2 Cleaning

Never use running water or high pressure when cleaning meters
Penetrating water can cause short-circuits. Send heavily soiled meters to the responsible service and repair centre, if necessary.

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8 Decommissioning, Disposal

This section explains the disconnection of the meter from the system and its correct disposal.

8.1 Decommissioning

The procedure for disconnecting and removing the meter from the mains is described in section 4.5.

8.2 Disposal

Based on the data specified in environmental certificate ISO 14001, the components used in meters are largely separable and can therefore be taken to the relevant disposal or recycling point.

Disposal and environmental protection regulations
For the disposal of meters observe the local disposal and environmental protection regulations in effect without fail.

Components	Disposal
Printed circuit boards	Electronic waste: disposal according to local regulations.
Metal parts	Sorted and taken to collective materials disposal point.
Plastic components	Sorted and taken to recycling (regranulation) plant or if no other possibility to refuse incineration.